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Abstract* — *This paper describes the goals, approaches, initial results, and preliminary implementation of WRT-1006, a multi-phase research task within the Systems Engineering Research Center (SERC). Evidence across the Services and industry has affirmed digital engineering is a critical practice necessary to support acquisition in an environment of increasing global challenges, dynamic threats, rapidly evolving technologies, and increasing life expectancy of our systems currently in operation. Digital engineering updates the systems engineering practices to take full advantage of computational technology, modeling, data analytics, and data sciences. The Department of Defense's vision for digital engineering is to modernize how the Department designs, develops, delivers, operates, and sustains systems, while continuing to practice systems engineering efficiently and effectively. Digital transformation is fundamentally changing the way acquisition and engineering are performed across a wide range of government agencies, industries, and academia. As the Department of Defense (DoD) transitions to digital engineering, there is a need to develop and maintain an acquisition workforce and culture that is literate in model-based engineering, competent in digital engineering models, methods, processes, tools, and understands digital artifacts across the acquisition lifecycle. One of the critical steps that was identified to enable this digital transformation is the development of a competency model that can be used to modernize the workforce.

This paper outlines the results after completion of Phase 1 of WRT-1006, which concluded in the initial release of the Digital Engineering Competency Framework (DECF) by SERC, and the initial Phase 2 efforts of implementing the framework as a benchmark for the content of a digital engineering training curriculum. The purpose of the DECF is to provide clear guidance for the DoD acquisition workforce, in particular the engineering acquisition workforce, through clearly defined competencies that illuminate the knowledge, skills, abilities, and behaviors required for digital engineering professionals. The approach taken to develop the DECF drew from existing competency models in fields neighboring digital engineering and from the feedback of experienced practicing digital engineering community.

The initial version of the DECF v.1.0 was released as a key WRT-1006 Phase 1 result with confidence in the maturity of the structure and general content. The overarching structure of the DECF v.1.0 consists of competency areas, proficiency levels within the competency, and constituting knowledge, skills, abilities, and behaviors (KSABs). Now that this benchmark is established, the second phase of our project involves the comparison of the DECF to the existing Defense Acquisition University (DAU) curriculum to determine what elements of such existing curriculum already support the competencies in the model. This is a bidirectional analysis that will both identify gaps in the training curriculum and potentially identify curriculum content that should be incorporated into the competency model. Although this project is specifically applying the DECF to the acquisition process, the model has applications in any area that will implement Digital Engineering initiatives. Furthermore, this framework has additional use cases that will be explored further including hiring for Digital Engineering positions and ensuring the current work force has the necessary skillsets to adequately implement a digital transformation.

Keywords—Digital Engineering, digital transformation, competency model, framework, Model-Based Systems Engineering (MBSE), acquisition and engineering workforce

I. Introduction

Evidence across the Services and industry has affirmed digital engineering is a critical practice necessary to support acquisition in an environment of increasing global challenges, dynamic threats, rapidly evolving technologies, and increasing life expectancy of our systems currently in operation. The DoD must continue to practice systems engineering efficiently and effectively, to provide the best advantage for successful acquisitions and sustainment. Digital engineering updates the systems engineering practices to take full advantage of

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computational technology, modeling, data analytics, and data sciences.

In 2019, the SERC was tasked with the WRT-1006 project which entailed the development of the DECF. Phase 1 of this project entailed the creation of the initial version of the DECF and was completed in July 2020. Phase 2 of the project is currently in progress and aims to continue refining the DECF while also beginning to apply the framework to analyzing gaps in the DAU curriculum. The team's IEEE Systems Conference (SYSCON) 2020 paper [1] introduced the WRT-1006 Phase 1 project and covered the motivation and early progress on the DECF. This paper provides an update on the results of Phase 1 [2] and introduces the efforts made in Phase 2.

This research task (Phase 2) is a continuation of Phase 1 and focuses on mapping existing DoD digital engineering training resources against the DECF to identify gaps and provide recommendations on how to build the digital engineering competency of the DoD workforce. The current DAU digital engineering curriculum was analyzed against the DECF to:

- Identify which competencies are already covered within the existing curriculum;
- Identify clear gaps between the existing curriculum and the DECF; and
- Create specific recommendations for training that could help address DECF competencies that are not currently covered in curriculum.

The purpose of the DECF is to provide clear guidance for the DoD acquisition workforce, in particular the engineering (ENG) acquisition workforce, through clearly defined competencies that illuminate the KSABs required for digital engineering professionals. Though the sponsor of the research task is the DoD and the DECF will include considerations specific to the Defense acquisition workforce, data will be gathered from outside the defense community and the structure of the DECF provides a useful model for any individual or organization that needs to understand the skills required to successfully implement digital engineering.

II. Background and Research Overview

The WRT-1006 project was created along with several other initiatives to support the Digital Engineering Strategy released by the Office of the Under Secretary of Defense and Research and Engineering in June 2018 [3]. This strategy recognized the need to begin a digital transformation in the workforce and workflows of the defense acquisition community. The creation and implementation of the DECF is one step in supporting this transformation. More about the motivations and background of this research can be found in last year's paper along with a deeper analysis of the use cases of the DECF model [1].

Figure 1 depicts an overview of the approach used for model development throughout Phase 1 and leading into Phase 2 of the project. Literature review of both DoD and non-DoD competency models were used to develop a draft model that was then reviewed by subject matter experts (SMEs) through a series of workshops. At appropriate points, the draft model(s) were

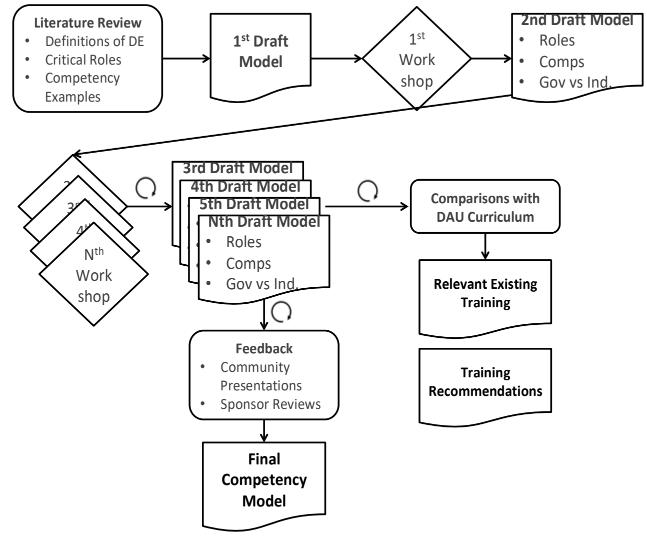

Figure 1: DECF Research Approach

assessed through community presentations and sponsor engagement.

Paired with the assessment of existing models, experts and practitioners in digital engineering and model-based systems engineering (MBSE) provided insights into their common activities, current training programs, etc. These inputs were collected and compared to existing competency models to determine where these fit in the existing frameworks and where new competencies needed to be created to account for them.

Now that the project has progressed to Phase 2 and the model is sufficiently mature, it is being compared with the existing DAU curriculum (acquisition and ENG) to determine what elements of such existing curriculum already support these competencies. Gaps will be noted within the curriculum and the competency model, and training recommendations will be developed. As with the development of the model itself, this will be an iterative process.

As part of this iterative review process, team constructed a Systems Modeling Language (SysML) model that captured the structure of the DECF and populated the model with an initial group of competencies and corresponding KSABs. This SysML model functioned as the authoritative source of truth for the model information, and as such, a limited number of shareholders had access to directly editing the model. Instead, the model was exposed into OpenMBEE's View Editor, which is a collaborative, web-based, model-based engineering environment [4]. Figure 2 shows the OpenMBEE structure of the DECF.

This interface captures comments and revisions to the model and can create offline documents of the model for distribution purposes. This enables interaction with the model for any interested parties, regardless of SysML modeling experience level, and fosters a collaborative process without risking model integrity. This practice was used to both internally and externally review the model and was also used to solicit feedback on the contents. Once the development process of the model was nearing its end and the DECF was published, additional capability was added to the model to utilize it in the comparison

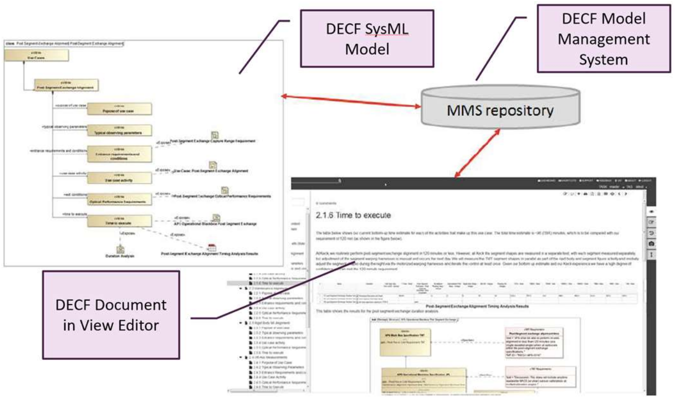

Figure 2: Overview of the DECF OpenMBEE Structure

between the DECF and the DAU curriculum and in visualizing the model structure.

III. Digital Engineering Competency Framework v.1.1

The first official version of the DECF v.1.0 was released in July 2020 and functioned as the conclusion of Phase 1 of the WRT-1006 project. This version is finalized in structure and can be reviewed online at the SERC's website [5]. Since then, DECF v.1.1 has been released with updates from feedback and the review of the DAU curriculum. An overview of the structure of DECF v.1.1 can be found in Figure 3.

This framework is based in part on DoD Instruction 1400.25, volume 250, "DoD Civilian Personnel Management Systems: Civilian Strategic Human Capital Planning", which outlines five tiers of competencies:

- Tier 1 – Core Competencies, which apply across DoD regardless of DoD component or occupation.
- Tier 2 – Primary Occupational Competencies, which apply across discrete occupational series and or functions.
- Tier 3 – Sub-occupational Specialty Competencies, which are unique to sub-occupational specialties.
- Tier 4 – DoD Component-Unique Competencies, which are so unlike any of the other competencies identified that they exist at the component level and are unique to the context or environment in which the work is performed.
- Tier 5 – Position-Specific Competencies, which are required for a particular position within an occupation and are not addressed in tiers above.

The DECF addresses competencies in Tiers 2-5, with Tier 2 for acquisition professionals and Tier 3 specifically for acquisition ENG professionals being the primary focus. Where competencies apply to additional acquisition roles (e.g. PM, IT, logistics, test and evaluation), these may also be highlighted. Though focused on the DoD, the overarching framework is intended to be relevant to a wide variety of stakeholders across government and industry, and should provide critical insights for any organization looking to successfully implement digital engineering.

The overarching structure of the DECF consists of competency groups, competency areas, proficiency levels in the competency, and constituting KSABs:

- Competency Group – Overarching organizational groups of competency areas with a common theme or application.
- Competency Area – Major grouping of related KSABs that represents a core area of expertise in digital engineering; each competency will be identified by its title and includes a description that succinctly encompasses the general knowledge and skills related to said competency.
- Proficiency Level – For each competency area, there will be five possible levels of attainment or proficiency: awareness, basic, intermediate, advanced, and expert.
- KSAB – A brief statement of knowledge, skill, ability, or behavior related to a competency area and associated with a specific proficiency level in said competency.

The DECF v1.1 of the model is constituted of the following five competency groups comprising of a total of 25 competency areas along with a separate foundational competency group of six additional competency areas:

1. **Data Engineering** – This group consists of areas related to inputting, collecting, or processing data resulting from a digital engineering environment, along with the ability to create or support such data-focused processes. It consists of the following areas:
    - **Data Governance** – This is a collection of practices and processes which help to ensure the formal management of data assets within a digital enterprise. Data Governance practices help an enterprise gain better control over its data assets, including methods, technologies, and behaviors around the proper management of data. Data Governance also entails security and privacy, integrity, usability, integration, compliance, availability, roles and responsibilities, and overall management of the internal and external data flows within an organization.
    - **Data Management** – Data management is applying policies, procedures, and information technology to plan for, acquire, access, manage, protect, and use data of a technical nature to support the total life cycle of the system. Data management includes verifying that all the data are secure, collected, documented, and archived along with descriptions of data to ensure completeness of data collected. Data management also ensures the distribution of data is in accordance with the data management plan for analysis.
2. **Modeling and Simulation** – Modeling and simulation in the digital enterprise environment is the process of creating and analyzing a digital prototype of a physical model to predict its performance in the real world. Modeling and simulation is used to help system designers and engineers understand whether, under what conditions, and in which ways a system component could fail and what loads it can withstand through analysis. This involves the application of

artificial intelligence (AI)/ machine learning (ML) in modeling and simulation of the digital enterprise. Data visualization is also an important part of modeling and simulation to present the data in clear and concise manner to support decision making.

- **Modeling** – Modeling is essential to aid in understanding complex systems and system interdependencies, and to communicate among team members and stakeholders.
- **Simulation** – Simulation provides a means to explore concepts, system characteristics, and alternatives; open up the trade space; facilitate informed decisions and assess overall system performance.
- **Artificial Intelligence/Machine Learning** – AI is the ability of machines to perform tasks that normally require human intelligence. ML is the application of AI that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. ML focuses on the development of computer programs that can access data and use it to learn for themselves.
- **Data Visualization** – Data visualization is the creation of graphic representations of data, particularly to improve communication about that data. Data visualization is also the ability to identify patterns, trends, and correlations in the data and place them in a visual context to describe their importance. This entails building and managing data visuals, models, and artifacts.
- **Data Analytics** – This is the process of inspecting, cleansing, transforming, modeling, and simulating data with the goal of discovering useful information, informing conclusions, and supporting decision making.

3. **Digital Engineering and Analysis** – This is a broad grouping of all competencies related to the practice of digital engineering and competencies that enable successful digital engineering projects. It consists of the following areas:

- **Model-Based Systems Engineering Processes** – The formalized application of modeling to support system requirements, design, analysis, verification, and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases.
- **Digital Architecting** – These activities use digital models to define a comprehensive digital system model based on principles, concepts, and properties logically related to and consistent with each other. Digital architecture has features, properties, and characteristics which satisfy, as far as possible, the problem or opportunity expressed by a set of system requirements (traceable to mission/business and stakeholder requirements) and lifecycle concepts (e.g., operational, support) and which are implementable through digital enterprise related technologies. Digital Architecture competencies relate to the ability to create system digital models and required architectural products and digital artifacts for a system or system-of-systems in accordance with applicable standards and policies.
- **Digital Requirements Modeling** – Digital Requirements Modeling refers to being able to capture stakeholder high-level requirements by documenting stated needs in the form of a model, assist in the clarification and translation of need statements into a more digital engineering-oriented basis, create and derive system requirements, related to system architecture definition. It is also used to establish requirements traceability throughout the digital model architecture, to examine the relationships of requirements to digital artifacts, and to trace design solutions to requirements, and to ensure designs can be traced to the system capabilities and requirement sets within digital enterprise environment.
- **Digital Validation and Verification** – This is the process for determining whether a product fulfills the requirements or specifications established for it, by using digital models and artifacts for testing and verification. Enabling this practice is important to ensure that digital practices correlate well with their real-world projects.
- **Digital Model-Based Reviews** – The series and sequence of model-based systems engineering activities which bring stakeholders to the required level of commitment, prior to formal reviews. This utilizes system models, artifacts, and products for analysis of design and technical reviews to execute trade-off and design analyses, prototyping, manufacturing, testing, and sustainment of the system.
- **Digital Engineering Policy and Guidelines** – This focuses on identifying process improvements to model-based engineering methods and contributing to the organization of system lifecycle development standards and definition of best practice. It includes defining strategy and approach to be used for modeling and analysis of complex systems.
- **Program Management** – This area relates to any skills related to planning, coordinating, and monitoring the work activities needed to deliver a product, service, or enterprise endeavor within the constraints of schedule, budget, resources, infrastructure, and available staffing and technology.
- **Organizational Development** – This area focuses on developing organizational policies, standards, and guidelines for model-based systems engineering methods and artifacts.
- **Configuration Management** – This area refers to the development of configuration management strategies, policies, standards, and guidelines for digital engineering related artifacts in accordance with MBSE methods. Managing these overarching configurations is vital to ensuring an organization maintains uniform digital engineering practices which enables efficient communication and ensures data integrity.

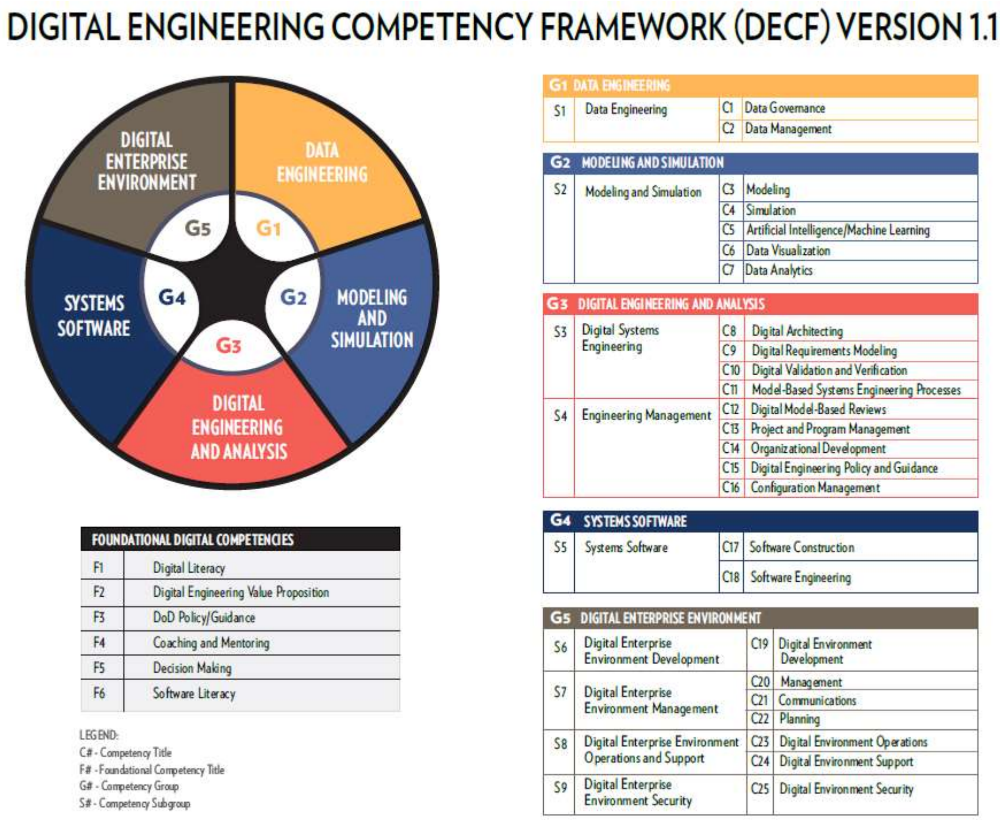

Figure 3: DECF v.1.1 Overview

4. **Systems Software** – Each organization practicing digital engineering will maintain a suite of various software and analysis platforms that will enable successful digital engineering practices. The following competency areas relate to the creation and management of these systems:
   - **Software Construction** – Software Construction refers to the detailed creation of working software through a combination of coding, verification, unit testing, integration testing, and debugging.
   - **Software Engineering** – Software Engineering is the systematic application of digital engineering approaches to the development of software.
5. **Digital Enterprise Environment** – This group consists of all competencies related to the development, management, and operational success of a digital environment. It consists of the following areas:
   - **Digital Environment Development** – A digital enterprise environment is an integrated digital development framework in which digital models and representations are interconnected such that the content and activities within it are managed to accomplish the organizational objectives of the enterprise.
   - **Management** – This area relates to KSABs that enable a framework that ensures transformational processes in enterprises occur with pace, high-quality and security. It does this through a set of IT solutions that are designed to make digital businesses fast, seamless, and optimized at every level.
   - **Communications** – This involves using digital model artifacts from the digital enterprise environment to investigate and manage the adoption of appropriate model-based tools, techniques, and processes for the operation of digital enterprise environment systems and services. Communications also establishes the appropriate guidance to enable transparent decision-making to be accomplished, allowing senior leaders to ensure the needs of principal stakeholders are understood, the value proposition offered by digital enterprise environment is accepted by stakeholders and the evolving needs of the stakeholders and their need for balancing benefits, opportunities, costs and risks is embedded into strategic and operational plans.
   - **Planning** – This includes establishing strategies to monitor and manage the performance of digital artifacts and services, in respect to their contribution towards enterprise performance goals. Planning ensures that a framework of policies, standards, processes, and practices is in place to guide provision of digital enterprise environment services, and that suitable monitoring of the governance framework is in place to report on adherence to these obligations.
   - **Digital Environment Operation**s – This includes creating digital models and simulation artifacts and technology roadmaps, and sharing knowledge and insights from processes and results, with others. It encourages adoption to changes in the digital enterprise

environment process or technology. It includes setting parameters for the prioritization of digital resources and the changes to be implemented and the configuration of digital engineering methods and tools to address the project needs.

- **Digital Environment Support** – Support within a digital enterprise environment includes abilities to develop, mature, and implement methods and processes to support digital enterprise environment activities across the enterprise and lifecycle.
- **Digital Environment Security** – This includes developing policies, standards, processes, and guidelines to ensure the physical and electronic security of digital environments and automated systems. This includes performing security risk and vulnerability assessments, and business impact analyses related to security and information assurance in the digital enterprise environment. It is intended to provide advice and guidance on the application and operation of digital environment physical, procedural, and technical security controls.

❖ **Foundational Digital Competencies** – Several competency areas have been identified that are integral to enabling the digital transformation and digital practices in general but that are not necessarily Digital Engineering competencies. These competencies were deemed important to include in the DECF but also should be clearly separated from the five primary DECF competency areas:

- **Digital Literacy** – Digital literacy means having the skills you need to live, learn, and work in a society where communication and access to information is increasingly through digital technologies. Digital literacy looks beyond functional IT skills to describe a richer set of digital behaviors, practices, and identities. It is common for individuals to struggle with trusting the digital environment; areas that arise include understanding how 'versioning' works in a model versus a traditional document and how cloud computing works. When these are not understood, the modeling environment is not trusted, and individuals are likely to find ways to work around the digital engineering process. This includes the ability to communicate, locate, protect, and preserve information on digital platforms.
- **Digital Engineering Value Proposition** – The body of the DECF assumes that individuals understand why digital engineering is important. However, as the team has worked with government and industry personnel over the last 18 months, this cannot be assumed. One of the foundational pieces of knowledge is the understanding of why digital engineering provides value and what specific values digital engineering is expected to provide.
- **DoD Policy/Guidance** – Individuals need to be aware of the DoD policies around DE and how individuals are expected to operate in a digital environment.
- **Coaching and Mentoring** – Coaching and mentoring competencies within the digital enterprise domain focus on the aspect of senior or more experienced individuals acting as advisors or counselors to junior level incumbents, on systems modeling and analysis.
- **Decision Making** – This group encompasses competencies related to using data of all sorts to perform analysis and make decisions in a digital environment. This includes the ability to correctly leverage digital resources to make and effectively relate decisions. This includes the abilities to use analysis tools and techniques to make appropriate decisions.
- **Software Literacy** – Technical expertise in various software or coding languages will be necessary for many roles in a digital engineering environment. This ability may range from simply opening documents within specific software to creating, supporting, and maintaining applications. This includes the abilities to understand, apply, problem solve, create, and critique software in pursuit of particular learning and professional goals.

In total, the DECF v.1.1 contains six hundred fifty-nine KSABs divided between these competency areas. Each represent a unique and important aspect of what will enable a successful digital transformation and productive digital engineering practices. The distribution of these KSABs in terms of both their competency area and respective proficiency level is shown in Table 1. The v.1.1 of the DECF is still a work in progress and there are still newly made competency areas such as Data Visualization. It is important to note that the KSABs within each competency are specifically targeted to digital engineering. Therefore, a generally broad competency area like Communications has a relatively low number of KSABs related to digital engineering, while a specific area like Model-Based Systems Engineering Processes that is intrinsically linked with digital engineering has a large number of KSABs.

It is also interesting to note the distribution of the KSABs across the five proficiency levels. KSABs at the Awareness and Basic levels represent broad fundamentals within a competency area, while KSABs at the Advanced and Expert levels include the practice of specific techniques that make up the various applications of the competency area. The DECF is established to be a general framework that can be used to create specific competency models that will be tailored based on component implementation of the Digital Engineering Strategy. As a result, the KSABs must cover the breadth of potential digital engineering practices, even if all these practices are not utilized within every organization.

It is important to note that the DECF is established as a competency framework instead of a competency model and as such will be implemented differently for each respective organization. This distinction is made to enable the DECF to flexibly serve as a standard for various shareholder organizations that have wholly different functions and workforce needs. These organization can tailor their specific competency model by selecting KSABs out of the DECF that are deemed necessary for their business or workflow. This subset of KSABs will still be traceable to the DECF standard while ensuring that each organization's competency model is streamlined to suit their needs and aid in the use cases described above.

IV. Technologies in the DECF

A common subject of concern from external reviewers and shareholders was that the DECF competency areas did not cover all relevant emerging technologies in digital engineering. The DECF is structured in a manner intended to concisely captures the breadth of digital engineering enabling skills with a minimal number of competency areas. Most technologies are inherently multidisciplinary in practice, and so creating distinct competency areas for each potentially relevant technology would create significant overlaps in the framework. To demonstrate this potential overlap, three noteworthy digital engineering enabling technologies were identified and analyzed:

- Digital Twin: An integrated multiphysics, multiscale, probabilistic simulation of an as-built system, enabled by Digital Thread, that uses the best available models, sensor information, and input data to mirror and predict activities/performance over the life of its corresponding physical twin [6].
- Digital Thread: An extensible, configurable, and component enterprise-level analytical framework that seamlessly expedites the controlled interplay of authoritative technical data, software, information, and knowledge in the enterprise data-information-knowledge systems, based on the Digital System Model template, to inform decision makers throughout a system's life cycle by providing the capability to access, integrate and transform disparate data into actionable information [6].
- Digital Artifact: An artifact produced within, or generated from, the digital engineering ecosystem. These artifacts provide data for alternative views to visualize, communicate, and deliver data, information, and knowledge to stakeholders [6].

These technologies are all enablers of the digital transformation and were often the subject of questions by reviewers of the DECF. An analysis of the DECF showed that each of these technologies had several dozen corresponding KSABs across various competency areas. There were fifty-five KSABs related to Digital Artifacts spread across ten different competency areas, thirty-two KSABs related to Digital Twin found in seven competency areas, and another thirty-two KSABs related to Digital Thread technology in eleven different competency areas. Each of these technologies has more associated KSABs that several of our individual competency areas included in the DECF. However, the spread of these KSABs across the variety of competency areas demonstrates the inherent interdisciplinary nature of these technologies and how much overlap would occur if they were uniformly included as their own competency area. The exception to this rule is the competency area for machine learning and artificial intelligence, which was deemed both vital for inclusion and unique in its content. In the future there may be some additional unique, self-contained technologies that may also warrant their own competency areas in future iterations of the DECF.

V. Comparison to the DAU Curriculum

The creation of training programs/curricula require that there be clearly established overarching learning objectives that are deemed important for the workforce. Tying these learning objectives to elements in a common competency model/framework creates a transparent and consistent measure of the content in said curricula. Existing training curricula need to be compared against the competency model to determine where training already exists, where training can be modified, and where true gaps in training exist that do not currently address major challenges.

Similarly, the content in the initial version of the DECF resulting from Phase 1 required validation of its content. The first step in applying and validating the contents of the DECF is to compare it to the DAU training curriculum. One of the primary planned use cases of the DECF is for it to be applied as a standard to ensure that an organization has sufficient training to develop the necessary digital engineering skills in its workforce. As such, Phase 2 of the WRT-1006 project began with an analysis of the current DAU Models, Simulations, and Digital Engineering course curriculum. The comparison to the DAU curriculum will function as both a demonstration of one of the use cases of the DECF and as an additional review process for the contents of the competency model against an established standard. The curriculum content was analyzed in comparison to the DECF version that resulted from Phase 1 of the project. This process was bidirectional and helped identify any missing KSABs in the DECF or major gaps in the curriculum, where modifications of the existing programs will help address digital engineering needs.

The content from the DAU course was reviewed for both enumerated and intrinsic learning objectives. These top-level learning objectives identify the overarching themes in the learning material. In addition to these central themes, the specific teaching points in the curricula are identified as taught KSABs and documented to capture the full extent of the learning material. These objectives and taught KSABs are then mapped to relevant KSABs from the DECF. Once this process is complete, it becomes apparent which learning objectives are not represented in the competency model and what digital engineering gaps there are in the DAU curriculum. Figure 4 shows the DAU course content distribution when compared to the KSABs in the DECF. Less than half of the KSABs and learning objectives identified in the DAU curriculum initially corresponded to KSABs found in version 1.0 of the DECF. Several gaps were identified in the DECF through this comparison and were remedied in DECF v.1.1. There are still some DAU KSABs that are not covered in DECF v.1.1, but these were deemed outside of the scope of our framework. It is also clear that the DAU curriculum has some significant gaps as it only covers 152 of the KSABs in the DECF.

One of the outcomes of this analysis is the recognition that training will not be responsible for developing the more technical, higher proficiency level KSABs. These competencies will be developed and demonstrated through on-the-job experience. Instead, the training curriculum is expected to cover the KSABs at Basic and Awareness proficiency levels along with the occasional Intermediate KSABs that provide the knowledge base to successfully conduct digital engineering practices and prepare trainees for integration into a digital engineering environment. Recognizing this fact not only guides the content included in future teaching curricula, but also demonstrates the need to establish and maintain on-the-job training programs to ensure these higher proficiency KSABs are developed in their workforce.

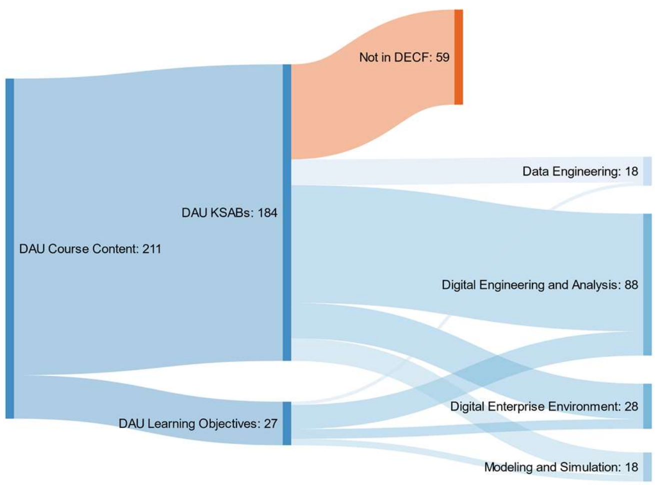

Figure 4: DAU Course Content Distribution in the DECF v1.1

Along with its application in sculpting a rigorous digital engineering curriculum, the DECF has several other important use cases in practice that will continue to be explored going forward. One of the most critical use cases for the DECF is to enable hiring for digital engineering positions. Competency models and frameworks are used by hiring managers to ensure that individuals have the required and appropriate skillsets to adequately perform their jobs. They are also used to evaluate the state of the workforce, to guide and plan careers, to identify critical roles, and to create position descriptions in the talent search process. These use cases are detailed further in the previous year's paper [1].

VI. Conclusion and Future Plans

The DECF is intended to provide a comprehensive overview of the skills required for individuals to support acquisition in a digital environment. The overarching DECF v.1.1 framework consists of foundational digital competencies along with 5 competency groups that are comprised of 25 competencies. Not every digital engineering professional will need to possess all KSABs and even every organization may not require all KSABs included. The model is intended to be tailored based on expectations for the needs of a given organization or role. This tailoring will be critical for successful implementation.

The initial efforts at demonstrating the use cases of the DECF had valuable insights and results. The comparison between the DECF to the DAU curriculum helped close gaps in the DECF and revealed shortcomings in the DAU training material. Going forward the team intends to continue to explore and demonstrate additional use cases such as the identification of key DE personnel/positions, defining the KSABs needed for roles/positions in an organization, and developing guided self-assessments of key personnel against the DECF to determine training needs.

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